Distr.
RESTRICTED

LC/R.379 (Sem.19/5)
19 October 1984
ENGLISH

ORIGINAL: SPANISH

E C L A C

Economic Commission for Latin America and the Caribbean

Workshop on Technical and Economic Co-operation for the Latin American Mining and Metallurgical Sector, organized by the Economic Commission for Latin America and the Caribbean (ECLAC) and the Latin American Integration Association (ALADI) under the auspices of the Commission of European Communities (CEC)

Santiago, Chile, 19 to 23 November 1984

DEMAND FOR MACHINERY AND EQUIPMENT BY THE METAL MINING INDUSTRY IN SOME COUNTRIES OF LATIN AMERICA

This report represents a working document prepared within the activities of the Joint ECLAC/UNIDO/UNDP Regional Project "The present situation of and prospects for the supply and production of capital goods in Latin America", (RLA/77/015).

84-10-1793

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Summary and conclusions

The research conducted shows the significance of demand for mining machinery and equipment in Latin America. In five South American countries alone (Argentina, Brazil, Chile, Peru and Venezuela) demand for this type of goods, generated exclusively by the metal mining sector, will amount to approximately US$ 6 billion at 1983 prices during the next 10 years.

Of this figure, around US$ 2.7 billion corresponds to machinery and equipment demand resulting from the entry into operation of new mines and US$ 590 million to equipment replacement needs in mines currently in operation. The figure representing spare parts is approximately US$ 2.1 billion, and raw materials (steel) will amount to US$ 850 million.

The most important products in the structure of mining machinery and equipment demand for new projects are "excavators" (22% of the total), "off-road trucks" (20%) and mills (26%), which together will amount to around US$ 1.6 billion in the next 10 years. In the structure of replacement goods "off-road trucks" are the most outstanding product, attaining a share in the total replacement investment on the order of 34%.

A significant portion of mining investment is made up of metallic structures and relatively simple boiler-making products whose manufacture could be met by the metal-working industry of most of the countries of the region where there is mining activity of some significance.

Estimates of machinery and equipment demand were based on a calculation of the requirements of these goods resulting from existing mining projects and from replacement of them in the mines operating at the end of 1982. The difficult situation being experienced by the world economy and especially by the majority of the Latin American countries may have a negative influence on investment prospects and upset the chronology of estimated demand for the next 10 years. At any rate, even assuming that there will be a significant decrease in the magnitude of that demand, the resulting amounts will continue to comprise a substantial volume of goods nearly all of which presently comes from abroad.

INTRODUCTION

ECLA, under the auspices of the United Nations Development Programme (UNDP), s developing a project 1/ designed to analyse the current situation and future prospects of Latin American capital goods production.

To carry forward this initiative, designed to help the region to make better use of the opportunities for industrial progress offered by its own needs, work has begun on a set of tasks designed to appraise demand from the main productive sectors in order subsequently to qualify its features and compare it with the supply capacity of the countries of the region.

Given the fact that the capital goods universe is very broad and varied, we have thought it appropriate to give priority to sectors whose demand corresponds mainly to boilers, heavy and semi-heavy machinery and major electrical equipment. This priority is justified by the relative magnitude of needs for this type of goods and the fact that most of them are comprised of elements of different levels of complexity whose manufacture requires participation by enterprises of different degrees of technological advancement. In other words, priority has been given to sectors whose demand, besides being of a significant absolute magnitude, may plausibly be satisfied with goods manufactured locally through a regional co-operation effort participated in not only by the industries of the large countries but also by those of the medium-sized and small countries.

To explore these possibilities it is necessary to conduct an analysis, for which very little background material is available. We have thus thought it appropriate to submit the results of each stage of the work carried out in each specific sector to the consideration of interested governmental and industrial entities. The criticisms and suggestions received will enrich not only the sectoral work itself but the subsequent joint consideration of similar needs from other fields of economic activity.

In accordance with the foregoing, we submit this document, which deals with the machinery and equipment needs for the metal mining industry in several countries of Latin America for the time period 1983-1992.

1/ Project RLA/77/015 on the current situation and prospects for the supply and production of capital goods in Latin America.

The project's working team wishes to express its appreciation for the valuable support it has received from the Instituto Nacional de Industrias de España, through its Division del Carbón, which effected its assistance with the help of the efficient collaboration of the mining engineers, Pedro Martínez Arévalo, José García Bernaldo de Quiroz and José Alvarez Santullano Alonso.

1. Objective of the study

Mining is a traditional and significant economic activity in more than a few countries of Latin America. In some of them, this activity, besides making a crucial contribution to formation of the product, is the main source of foreign currency for those countries, through exports of its production.

The maintenance and development of mining activity requires a supply of large volumes of machinery and equipment, some very specific and some commonly used for other productive activities, and nearly all of which is imported from the developed countries.

There is no known research which has attempted to quantify regional demand for capital goods intended for mining activity. The purpose of this study is to provide information on the probable magnitude and composition of that demand by means of research, carried out in several countries of Latin America, on requirements machinery, equipments and materials (steel) for metal mining -the most important branch of this productive activity, at the regional level- during the time period 1983-1992.

The research included mining machinery used both in preparing and working the mines and in ore dressing processess, including the equipment and installations necessary for moving and transporting the ore between the different operative centres in the deposits and those designed to supply the services which are absolutely necessary for the development of extraction and processing activities (ventilation, compressed air, water, electric energy, etc.). The study was limited to five countries of South America (Argentina, Brazil, Chile, Peru and Venezuela), where metal mining activity is the most significant. Mexico, a country where mining is also especially important, was not included, since there has been a recent study on capital goods demand for mining in that country, carried out by the Joint UNIDO-NAFINSA Project on Capital Goods. 2/

2/ Nacional Financiera, S.A. "La demanda de bienes de capital para la minería en México", Joint NAFINSA-UNIDO Project on Capital Goods, Mexico, 1982.

2. Applied methodology

There are two sources of generation of demand for mining machinery and equipment. One of them is new mining projects and the other, replacement of machinery and equipment in operating mines. Therefore, the first step of the research consisted of compiling the main features of the most important metal mining projects in the five countries under consideration, which were scheduled to enter into operation between 1986 and 1995, assuming that the machinery and equipment demand from those projects will coincide with the time period of the study (1983-1992) (see annex I).

At the same time, data was compiled on the main deposits currently in operation (a list of which appears in annex II), especially that relating to types of mines (undergound or open-cast), levels of production, fineness of ore, machinery and equipment used and "ratios" of raw materials consumption. In both cases, the data was mainly obtained through consultations with government officials on mining activity in the countries under consideration, executives and engineers from the most important mining companies, and from visits made to working mines in several of those countries.

In this way, valuable background material was obtained on the machinery and equipment used in the exploitation and dressing processes in the main mines and on the technology applied in those processes. This data was complemented with other data and background material from the ECLA offices, all of which made possible the selection of a representative sample of existing mines in operation in the countries considered by the study. The list of mines included in the sample is contained in annex IV.

An analysis of the equipment of the mines in the sample provided the necessary elements for estimating machinery and equipment requirements in terms of the main characteristics and different ranges of production of the deposits whose entry into operation is planned for the time period 1986-1995. To this end coefficients were determined between the ore extraction or production capacity of the deposits in each of the mines selected and the number 3/ of main pieces of equipment operating in the mines. A similar procedure was followed for ore dressing plants. The average coefficient thus determined was considered to be an acceptable indicator for estimating the probable machinery and equipment demand in new mines.

3/ In the case of some types of equipment or installations, the number of units was replaced by the amount of the respective investment expressed in North American dollars.

Table 1

THEORETICAL DEMAND FOR MACHINERY AND EQUIPMENT

Type of equipment		Copper mines Open Pit					Iron Ore Mines High Grade Open Pit					Copper and Polimetallic Mines underground				
		Mt/a 1	Mt/a 3	Mt/a 5	Mt/a 10	Mt/a 25	Mt/a 1	Mt/a 3	Mt/a 5	Mt/a 10	Mt/a 25	Mt/a 0/5	Mt/a 1	Mt/a 3	Mt/a 5	Mt/a 10
1. Rotary drill rigs, self propelled (6" to 12¼")	U	-	2	4	7	11	-	2	4	6	10	-	-	-	-	-
2. Miniwagons drill rigs, crawler type (3" to 6")	U	3	2	2	2	3	3	2	2	2	2	-	3	8	12	20
3. Paise borers	U	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1
4. Drill jumbos	U	-	-	-	-	-	-	-	-	-	-	4	7	15	20	25
5. Electric power shovels (3 to 10 yd.^{3})	U	-	2	3	3	4	-	2	3	3	4	-	-	-	-	-
6. Electric power shovels (over 10 yd.^{3})	U	-	-	3	6	12	-	-	3	6	12	-	-	-	-	-
7. Bucket loaders (5 to 7 yd.^{3})	U	3	2	2	2	2	3	2	2	2	2	1	2	3	4	6
8. Bucket loaders (over 7 yd.^{3})	U	1	2	3	4	6	1	2	3	4	6	-	-	-	-	-
9. Scooptrans (2 to 13 yd.^{3})	U	-	-	-	-	-	-	-	-	-	-	7	12	20	30	45
10. Off road trucks (35 to 70 t)	U	8	8	8	10	10	8	8	8	10	10	-	-	-	-	-
11. Off road trucks (70 to 170 t)	U	-	8	14	25	60	-	8	14	25	60	-	-	-	-	-
12. Low haulage trucks and dumpers (10 to 35 t)	U	-	-	-	-	-	-	-	-	-	-	2	4	8	14	20
13. Tractors, crawler or rubber tyred (200 to 700 HP)	U	3	6	9	12	20	3	6	9	12	20	1	1	1	2	3
14. Civil construction equipment (scrapers, graders, etc.)	U	3	4	5	7	10	3	4	5	7	10	3	3	5	6	10
15. Service vehicles (personnel and materials)	$	0.4	0.5	0.6	0.8	1.0	0.4	0.5	0.6	0.8	1.0	0.3	0.4	0.6	0.8	1.2
16. Small mining equipment (air drills)	$	0.3	0.4	0.5	0.6	0.9	0.3	0.4	0.5	0.6	0.9	0.2	0.4	0.8	1.2	1.8
17. Hoisting machinery	$	-	-	-	-	-	-	-	-	-	-	0.8	1.2	2.0	2.5	3.5
18. Gyratory crushers (42" x 65" to 54" x 74")	U	1	1	-	-	-	1	1	-	-	-	-	-	-	-	-
19. Gyratory crushers (60" x 89" to 60" x 109")	U	-	-	1	1	2	-	-	1	1	2	-	-	-	-	-
20. Jaw crushers (24" x 36" to 48" x 60")	U	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1
21. Cone crushers (5 1/2" to 7")	U	2	4	5	7	15	2	4	5	7	15	2	2	4	5	7
22. Grinding mills (up to 1000 HP)	U	3	4	4	6	-	-	-	-	-	-	3	3	4	4	6
23. Grinding mills (over 1000 HP)	U	2	4	6	10	20	-	-	-	-	-	2	2	4	6	10
24. Feeders, screens, cyclones	$	0.5	1.0	1.3	2	3.5	0.5	1.0	1.3	2.0	3.5	0.4	0.6	1.2	1.3	2
25. Flotation equipment (cells, pumps)	$	1.0	1.9	2.6	4.0	6.9	-	-	-	-	-	0.8	1.2	2.3	2.6	4
26. Thickeners, filters, dryers	$	1.0	1.9	2.6	4.0	6.9	-	-	-	-	-	0.8	1.2	2.3	2.6	4
27. Locomotives and wagons	$	0.4	0.8	1.0	1.6	2.8	0.4	0.8	1.0	1.6	2.8	0.4	0.6	1.2	1.8	3.0
28. Beltconveyors	$	1.0	1.2	1.4	1.9	2.7	1.0	1.2	1.3	1.5	1.7	0.6	0.8	1.2	1.6	2.5
29. Air compressors, dyraulic pumps, fans	$	2.0	2.5	2.8	3.0	3.3	0.5	1.0	1.3	1.5	2.0	1.8	2.0	2.5	2.9	3.5
30. Machine tools and tools for maintenance	$	0.2	0.3	0.3	0.4	0.6	0.2	0.3	0.3	0.4	0.6	0.4	0.6	1.0	1.5	2.3
31. Electrical equipment (transformers, panels)	$	2.3	3.0	3.3	3.8	5.0	1.5	2.0	2.3	3.0	4.0	1.8	2.3	3.0	3.5	4.5
32. Structural steel and boiler shop products	$	2.5	4.3	5.6	7.9	12.5	2.3	4.0	5.2	7.3	11.6	1.7	2.5	4.3	5.6	7.9
33. Roof bolters, breakers, exploration drills	$	0.2	0.3	0.3	0.5	0.8	-	-	-	-	-	0.6	0.8	1.1	1.5	2.0

Source: Economic Commission for Latin America and the Caribbean (ECLAC)
Mt/a: million metric tons ROM/yr.

Obviously, some operations, both in mines and ore dressing plants, can be carried out by different equipment or by similar equipment of different capacities, with the number of units varying. This made it necessary to adopt certain assumptions concerning the size and features of the equipment for the purpose of simplifying and facilitanting the assignment of equipment units or amounts of investment in machinery and installation to the different mines, in terms of the respective ranges of extraction and dressing capacity.

To facilitate the application of the criteria noted above for estimating the mining machinery and equipment requirements of the new projects, table 1 was prepared, indicating the theoretical demand of the different mining equipment in terms of the ore involved (Cu, Fe, high-grade and containing more than one metal) the expected level of production (millions of tons per year) and the type of mine (open-cast or underground).

With regard to open-cast iron mines, complete dressing plants have not been contemplated, but simply plants for crushing and classification, since all the projects involved concern high-grade mines (65%-69% Fe) which only require classification by size, to obtain marketable products.

To calculate the probable demand from replacement needs of the equipment which is operating in working mines and that to be installed in the mines which are to begin operation after 1986, certain assumptions were made. These are the following:

i) The useful life indexes of the equipment are closer to modern criteria in the field of replacement than to trends prevailing in this field in regional mining activity, and are indicated in table 2.

ii) The pool of renewable machinery and equipment in currently operating mines reached 50% of its useful life on 31 December 1982.

iii) The average life of a mine is considered to be 20 years, so that replacement of equipment whose useful life is 20 years or more is not considered.

An estimate has also been made of the spare parts necessary for maintenance and repair of mining machinery during the time period under consideration. To that end, percentages of the initial or purchase value of each piece of equipment have been hypothesized to represent the constant annual expenditure under this heading. These percentages are different for each piece of equipment or machinery, depending on its features and working conditions. They vary between 3% and 15% of the value of each new machine, and are also indicated in table 2.

Table 2

ECONOMIC LIFE SPAN OF MINING EQUIPMENT AND ANNUAL EXPENSES FOR SPARE PARTS AS PERCENTAGE OF THE INITIAL COST OF THE EQUIPMENT

	Years of economic life	Spare parts % each year
1. Rotary drill rigs, self propelled (6" to 12 1/4")	N.R.	5
2. Miniwagon drill rigs, crawler type (3" to 6")	10	10
3. Raise borers	N.R.	5
4. Drill jumbos	8	10
5. Electric power shovels (3 to 10 $yd.^3$)	N.R.	5
6. Electric power shovels (over 10 $yd.^3$)	N.R.	5
7. Bucket loaders (5 to 7 $yd.^3$)	8	12
8. Bucket loaders (over 7 $yd.^3$)	8	12
9. Scooptrans (2 to 13 $yd.^3$)	7	12
10. Off road trucks (35 to 70 t)	15	10
11. Off road trucks (70 to 170 t)	15	10
12. Low haulage trucks and dumpers(10 to 35 t)	10	10
13. Tractors, crawler or rubber tyred (200 to 700 HP)	8	15
14. Civil construction equipment (scrapers, graders, etc.)	12	10
15. Service vehicles (personnel and materials)	5	15
16. Small mining equipment (air drills)	10	10
17. Hoisting machinery	N.R.	3
18. Gyratory crushers (42" x 65" to 54" x 74")	N.R.	3
19. Gyratory crushers (60" x 89" to 60" x 109")	N.R.	3
20. Jaw crushers (24" x 36" to 48" to 60")	N.R.	3
21. Cone crushers (5 1/2" to 7")	N.R.	3
22. Grinding mills (up to 1000 HP)	N.R.	3
23. Grinding mills (over 1000 HP)	N.R.	3
24. Feeders, screens, cyclones	8	10
25. Flotation equipment (cells, pumps)	12	10
26. Thickeners, filters, dryers	N.R.	3
27. Locomotives and wagons	N.R.	3
28. Beltconveyors	N.R.	15
29. Air compressors, dyraulic pumps, fans	N.R.	3
30. Machine tools and tools for maintenance	N.R.	5
31. Electric equipment (transformers, panels)	N.R.	3
32. Structural -teel and boiler shop products	N.R.	-
33. Roof bolters, breakers, exploration drills	N.R.	10

Source: ECLAC
Mt/a: million metric tons ROM/yr.
N.R.: No replacement considered.

The monetary values of machinery and equipment demand have been determined on the basis of FOB port of embarkation or ex-works in the case of locally manufactured goods, and expressed in North American dollars at 1983 prices.

3. Findings and conclusions

The findings of the research carried out stress the significance of demand for mining machinery and equipment in Latin America. In five South American countries alone (Argentina, Brazil, Chile, Peru and Venezuela) demand for this type of goods, generated exclusively by the metal sector, will amount to approximately to US$ 6 billion at 1983 prices during the next 10 years (see table 3).

Of this figure, around US$ 2.7 billion corresponds to machinery and equipment demand resulting from the entry into operation of new metal mines, and US$ 580 million to equipment replacement needs in mines currently in operation.

The figure representing spare parts for maintenance and repair of equipment in the mines currently in operation and those to enter into operation in the coming years is also extremely important. It would be on the order of US$ 2.1 billion.

The materials (for crushing and drilling) required by metal mining activity in the countries under consideration, will amount to a figure of US$ 850 million.

Chile is the country where capital goods demand for metal mining is the highest. During the time period 1983-1992, metal mining activity in that country will require investments in machinery and equipment on the order of US$ 1.1 billion. In Brazil, demand will be US$ 700 million; in Peru, US$ 660 million; in Argentina US$ 225 million and in Venezuela much less, US$ 18 million (see tables 4 and 5).

Bearing in mind the final objective of this study, it is interesting to look into the structure of estimated mining machinery and equipment demand. Table 6 shows the combined pattern of demand of the five countries considered in this study, by type of machinery or equipment, differentiating those intended for new mining projects from those required by mines in operation for replacement of machinery or equipment which have completed their useful life.

It may be noted that the most important products in capital goods demand for new mining projects are "excavators", (22% of the total), "off-road trucks" (20%) and mills (16%). These three types of equipment add up to around US$ 1.6 billion, which represents nearly 60% of total investment in new projects during the next ten years.

Table 3

ARGENTINA, BRAZIL, CHILE, PERU, VENEZUELA: ESTIMATED DEMAND FOR EQUIPMENT AND FERROUS MATERIALS, 1983 TO 1992

	Millions of US$ at 1983 prices
Machinery and equipment for new mines and expansion schemes	2 731
Replacement of obsolete machinery and equipment	578
Spare parts	2 090
Materials for ore comminution	732
Materials for perforation	119
TOTAL	6 250

Source: ECLAC

Table 4

ESTIMATED MACHINERY AND EQUIPMENT DEMAND OF NEW MINES AND EXPANSION SCHEMES IN ARGENTINA, BRAZIL, CHILE PERU AND VENEZUELA, 1982 TO 1992

Country	Millions of US$ at 1983 prices
Argentina	225
Brazil	704
Chile	1 124
Peru	660
Venezuela	18
TOTAL	2 731

Source: ECLAC

Table 5

ESTIMATED DEMAND FOR MACHINERY AND EQUIPMENT DERIVED FROM PROJECTS FOR NEW MINES AND EXPANSION SCHEMES

	Argentina		Brazil		Chile		Peru		Venezuela	
	Units	10^6US$	Units	10^6US$	Units	10^6US$	Units	10^6US$	Units	10^6US$
1. Rotary drill rigs, self propelled (6" to 12 1/4")	14	12.60	37	33.30	64	57.60	32	28.80	-	-
2. Miniwagons drill rigs,crawler type (3" to 6")	4	0.28	15	1.05	21	1.47	18	1.26	1	0.07
3. Raise borers	-	-	-	-	-	-	-	-	-	-
4. Drill jumbos	-	-	-	-	-	-	10	2.50	-	-
5. Electric power shovels (3 to 10 $yd.^3$)	6	8.40	23	36.40	30	49.00	19	30.80	2	2.80
6. Electric power shovels (over 10 $yd.^3$)	12	40.80	45	153.00	60	204.00	23	78.20	-	-
7. Bucket loaders (5 to 7 $yd.^3$)	4	1.00	17	4.25	18	4.50	22	5.50	1	0.25
8. Bucket loaders (over 7 $yd.^3$)	8	3.20	28	11.20	38	15.20	22	8.80	-	-
9. Scooptrans (2 to 13 $yd.^3$)	-	-	-	-	-	-	16	3.52	-	-
10. Off road trucks (35 to 70 t)	20	7.40	72	26.64	77	28.49	72	26.64	10	3.70
11. Off road trucks (70 to 170 t)	50	35.00	212	148.40	272	190.40	121	84.70	-	-
12. Low haulage trucks and dumpers (10 to 35 t)	-	-	-	-	-	-	5	1.00	-	-
13. Tractors, crawler or rubber tyred (200 to 700 HP)	24	7.20	89	26.70	116	34.80	71	21.30	3	0.90
14. Civil construction equipment (scrapers,graders,etc.)	14	2.10	54	8.10	65	9.75	49	7.35	4	0.60
15. Service vehicles (personnel and materials)		1.60		5.50		7.20		5.80	-	0.50
16. Small mining equipment (air drills)		1.20		4.00		5.80		4.50	-	0.20
17. Hoisting Machinery	-	-	-	-	-	-		2.10	-	-
18. Gyratory crushers (42" x 65" to 54" x 74")	-	-	3	2.70	-	-	4	3.60	1	0.90
19. Gyratory crushers (60" x 89" to 60" to 109")	2	4.40	7	15.40	10	22.00	3	6.60	-	-
20. Jawcrushers (24" x 36" to 48" x 60")	-	-	-	-	-	-	3	0.60	-	-
21. Cone crushers (5 1/2" to 7")	14	3.50	59	14.75	72	18.00	46	11.50	2	0.50
22. Grinding mills (up to 1000 HP)	12	8.40	9	6.30	44	30.80	47	32.90	-	-
23. Grinding mills (over 1000 HP)	20	36.00	28	50.40	98	176.40	57	102.60	-	-
24. Feeders, screens, cyclones		4.00		14.80		19.70		12.00		1.00
25. Flotation equipment (cells, pumps)		8.00		9.20		39.20		24.50	-	-
26. Thickeners, filters, dryers		8.00		9.20		39.20		24.50	-	-
27. Locomotives and wagons		3.20		14.00		15.50		9.80		0.80
28. Beltconveyors		3.80		12.40		18.60		12.20		1.20
29. Aircompressors, dyraulic pumps, fans		6.00		13.60		27.10		24.70		0.50
30. Machine tools and tools for maintenance		0.80		3.20		3.50		3.20		0.30
31. Electrical equipment (transformers, panels)		7.60		24.10		35.40		27.20		1.50
32. Structural steel and boiler shop products		15.80		54.10		75.80		48.50		3.00
33. Roof bolters, breakers, exploration drills		1.00		1.40		4.70		3.88		-
TOTAL		225.00		704.00		1 124.00		660.00		18.00

Source: ECLAC.

Table 6

ESTIMATED MACHINERY AND EQUIPMENT REQUIREMENTS OF NEW MINING PROJECTS AND EXPANSION SCHEMES AND OF REPLACEMENT NEEDS IN ARGENTINA, BRAZIL, CHILE, PERU AND VENEZUELA, BY TYPE OF EQUIPMENT, 1983 TO 1992

	New Mining Projects and Expansion Schemes		Replacements	
	Units	10^6US$	Units	10^6US$
1. Rotary drill rigs, self propelled (6" to 12 1/4")	147	132	-	-
2. Miniwagon drill rigs, crawler type (3" to 6")	59	4	89	6
3. Raise borers	-	-	-	-
4. Drill jumbos	10	2	121	30
5. Electric power shovels (3 to 10 $yd.^3$)	93	130	-	-
6. Electric power shovels (over 10 $yd.^3$)	140	476	-	-
7. Bucket loaders (5 to 7 $yd.^3$)	62	16	98	25
8. Bucket loaders (over 7 $yd.^3$)	96	38	73	29
9. Scooptrans (2 to 13 $yd.^3$)	16	4	214	47
10. Off road trucks (35 to 70 t)	251	93	123	46
11. Off road trucks (70 to 170 t)	655	459	214	150
12. Low haulage trucks and dumpers (10 to 35 t)	5	1	46	9
13. Tractors, crawler or rubber tyred (200 to 700 HP)	303	91	251	75
14. Civil construction equipment (scrapers,graders,etc.)	186	28	131	20
15. Service vehicles (personnel and materials)	-	21	-	37
16. Small mining equipment (air drills)	-	16	-	17
17. Hoisting machinery	-	2	-	-
18. Gyratory crushers (42" x 65" to 54" x 74")	8	7	-	-
19. Gyratory crushers (60" x 89" to 60" x 109")	22	48	-	-
20. Jawcrushers (24" x 36" to 48" x 60")	3	1	-	-
21. Cone crushers (5 1/2" to 7")	193	48	-	-
22. Grinding mills (up to 1000 HP)	112	78	-	-
23. Grinding mills (over 1000 HP)	203	365	-	-
24. Feeders, screens, cyclones	-	52	-	49
25. Flotation equipment (cells, pumps)	-	81	-	26
26. Thickeners, filters, dryers	-	81	-	-
27. Locomotives and wagons	-	43	-	-
28. Beltconveyors	-	48	-	-
29. Aircompressors, dyraulic pumps, fans	-	72	-	-
30. Machine tools and tools for maintenance		11		
31. Electric equipment (transformers, panels)		96		
32. Structural (teel and boiler shop products)		197		
33. Roof bolters, breakers, exploration drills		11		13
TOTAL		2 732		579

Source: ECLAC.

With regard to the structure of replacement goods, "off-road trucks" are the most important product, and their share in total replacement investment is on the order of 34%.

Obviously, the pattern of demand should be borne closely in mind whenever the possibilities and appropriateness of studying the manufacture of mining equipment in the countries of the region are analysed. In this respect, the relative importance of the "metallic and boilermaking structures" heading should also be considered; it attains a figure of nearly US$ 200 million and encompasses only a portion of the boilermaking structures and pieces required in mining installations. Other products in the structure of demand, such as feeders, classifiers, screens and cyclones; oil thickeners and filters; conveyer belts, etc; include a good portion of boilermaking elements or pieces, which significantly raise the figures of the "metallic and boilermaking structures" heading, if they are considered separetely from the respective equipment.

This consideration may be of interest for those countries of the region which, although they have not attained a level of development in the metal-working area which will enable them to manufacture mining equipment of some complexity, are in a position to produce a good part of the structural and boilermaking elements which they are still importing and which represent substantial proportions of total mining investment.

This topic should no doubt be developed further. In order to do so, a detailed analysis of the different products making up mining equipment should be carried out, so as to classify their different parts and components in terms of their technological complexity and manufacturing procedures and requirements. This analysis would provide the necessary elements for defining the extent to which the metal-working industry of the different countries of the region could share in the partial or, in some cases total provision of mining equipment and its components.

At any rate, it would not be over bold to state that at least 40% of the products noted above is comprised of relatively simple boiler elements or parts whose manufacture could be met by the metal-working industry of most of the countries of the region where somewhat significant mining activity exists.

Finally, it should be pointed out that the amounts indicated in tables 3, 4 and 5 should be considered only as figures approximating the possible magnitude of demand for capital goods generated by metal mining development in some countries of Latin America and, at the same time, as a guideline for estimating, naturally in an even more approximate manner, the magnitude of that demand in the countries of the region as a whole.

These estimates will probably be somewhat overvalued. The difficult situation being experienced by the world economy, and especially the majority of the Latin American countries, and the depression which mineral prices are generally suffering as a result, may have a negative influence on investment prospects in the mining sector and upset the chronology of estimated demand for capital goods for the next ten years.

At any rate, even supposing a significant decrease in the magnitude of that demand, the resulting values would continue to represent a considerable volume of goods nearly all of which, as noted above, presently comes from abroad.

LIST OF NEW MINING PROJECTS: ARGENTINA, BRAZIL, CHILE, PERU AND VENEZUELA

Location	Firm	Mineral	Estimated Production 10^6 t ROM[a]/Yr.	Type of mine
Argentina				
El Pachón	Minera Aguilar	Cu,Mo	13	c.a.
Bajo de la Alumbrera	YMAD	Cu,Mo	13	c.a.
Brasil				
Carajas	CVRD	Cu	9	c.a.
Mararrosa	Eluma	Cu	20	c.a.
Pedra Verde	Minuisa	Cu	0.9	c.a.
Carajas	CVRD	Bauxit	1.5	c.a.
Trombetas	MRN	Bauxit	4 a 8 b/	c.a.
Oriximina	Alcoa-Shell	Bauxit	4	c.a.
Paragominas	CVRD	Bauxit	12	c.a.
Carajas	CVRD	Fe	35	c.a.
Timbotepa	CVRD	Fe	7.5 a 11.5 b/	c.a.
Aguas Claras	MBR	Fe	15 a 22 b/	c.a.
Mutuca	MBR	Fe	2.5 a 7 b/	c.a.
Chile				
Chuquicamata	CODELCO	Cu	c/	c.a.
Cerro Colorado	Río Chilex	Cu	6	c.a.
Quebrada Blanca	Falcon Bridge y otras	Cu	15	c.a.
El Abra	CODELCO	Cu	10	c.a.
La Escondida	UTAH INI	Cu	15	c.a.
Andacollo	ENAMI	Cu	10	c.a.
Los Pelambres	ANACONDA	Cu	10	c.a.
Los Broncos	EXXON	Cu	1.8 a 30 b/	c.a.
El Soldado	EXXON	Cu	13 a 20 b/	c.a.
El Soldado	EXXON	Cu	7 d/	c.a.
Perú				
Toro Mocho	CENTROMIN	Cu	10	c.a.
Tintaya	Minera Tintaya	Cu	2.5	c.a.
Tambo Grande	Minero Perú	Cu	3	c.a.
Antamina	Minero Perú	Cu	3	c.a.
Cerro Verde - Sulfuros	Minero Perú	Cu	7	c.a.
Michiquillay	Minero Perú	Cu	12	c.a.
Quellaveco	Minero Perú	Cu	10	c.a.
Berenguela	Minero Perú	Cu	1	c.a.
Colquijirca	Minera del Brocal	Cu,Zn,Pb,Ag	0.35	c.a. and sub.
Milpo	Minera Milpo	Pb,Zn,Ag	0.82	sub.
Aija	Minera Alianza	Pb,Zn	0.45	sub.
Venezuela				
Los Pijiguaos	BAUXIVEN	Bauxit	3	c.a.

a/ "Run of mine".
b/ Expansion.
c/ Expansion for maintaining production rate at 500 000 t/a
d/ New mine.
c.a. Open pit.
sub. Underground

Annex II

LIST OF EXISTING MINES: ARGENTINA, BRAZIL, CHILE, PERU AND VENEZUELA

Location	Firm	Mineral	Estimated Production 10^6 t ROM/Yr.	Type of Mine
Argentina				
Sierra Grande	HIPASAM	Fe	3	sub.
Minas 9 de octubre y Puestoviejo	DGFM	Fe	0.28	sub.
Estación 3 Cruces y El Aguilar	Minera Aguilar	Pb, Zn	0.7	sub.
Brazil				
Pocos de Caldas	Alcoa	Bauxit	0.5	c.a.
Minas Pocos de Caldas	CBA	Bauxit	0.5	c.a.
Saramenha	MRN,CVRD,otras	Bauxit	4	c.a.
Jaguarari	CARAIBAMETAIS	Cu	3	sub.
Camaqua	CBC	Cu	0.5	sub.
Caue	CVRD	Fe	36	c.a.
Conceicao-Dois Corregos	CVRD	Fe	25	c.a.
Periquito	CVRD	Fe	7	c.a.
Picarrao	CVRD	Fe	1.5	c.a.
Caraca	CVRD	Fe	2.5	c.a.
Capanema	CVRD	Fe	11.5	c.a.
Aguas Claras	MBR	Fe	15	c.a.
Pico Itabirito-Mutaca	MBR	Fe	4	c.a.
Timbopeba	MBR	Fe	7.5	c.a.
Alegria	SAMITRI	Fe	8	c.a.
Morro Agudo	SAMITRI	Fe	3	c.a.
Germano	SAMARCO	Fe	7	c.a.
Mina Fábrica	FERTECO	Fe	1.5	c.a.
Casa de Pedra	CSN	Fe	6	c.a.
Itabira	ITAMINAS	Fe	2	c.a.
Congonhas	W.H. Müller	Fe	1.6	c.a.
Corumba	M.C.R.	Fe	3	c.a.
Boquira	Minera Boquira	Pb	0.27	sub.
Adrianápolis	PLUMBUM S.A.	Pb	0.25	sub.
Bazante	CMM	Zn	0.30	c.a.

Cont. Annex II

Location	Firm	Mineral	Estimated Production 10^6 t ROM/Yr	Type of Mine
Chile				
Chuquicamata	CODELCO	Cu	25	c.a.
Salvador	CODELCO	Cu	8.5	sub.
Andina	CODELCO	Cu	4.6	sub.
El Teniente	CODELCO	Cu	21.5	sub.
Los Bronces	EXXON	Cu	2.5	c.a.
El Soldado	EXXON	Cu	1.2	sub.
Mantos Blancos	M. Blancos	Cu	4	sub. y c.a.
Sagasca	Minera Pudahuel	Cu	0.75	c.a.
Lo Aguirre	M. Pudahuel	Cu	0.90	c.a.
El Romeral	M.del Pacífico	Fe	5	c.a.
El Algarrobo	M.del Pacífico	Fe	5.4	c.a.
Los Colorados	M.del Pacífico	Cu	1.1	sub.
Peru				
Toquepala	Southern	Cu	16	c.a.
Cuajone	Southern	Cu	18	c.a.
Cobriza	CENTROMIN	Cu	3	sub.
Cerro Verde	Minero Perú	Cu	7	c.a.
Mina Aguila	M. Aguila S.A.	Cu	1	c.a.
Mina Raúl	M. Patavilca	Cu	0.3	c.a.
Anaychagua	Minero Perú	Cu	0.35	c.a.
Marcona	Minero Perú	Fe	12	c.a.
Morococha	CENTROMIN	Cu, Pb, Zn	0.53	sub.
Cerro de Pasco	CENTROMIN	Cu, Pb, Zn	2.10	sub.
Casa Palca	CENTROMIN	Pb, Ag	0.50	sub.
San Cristóbal	CENTROMIN	Pb, Zn	0.50	sub.
Yauricocha	CENTROMIN	Cu, Pb, Zn	0.30	sub.
Colquijura	Minera El Brocal	Cu, Pb, Zn	0.12	c.a.
Milpo	Minera Milpo	Pb, Zn, Ag	0.55	sub.
Morococha	Minera San Ignacio de Morococha	Pb, Cu, Zn	0.60	sub.
Venezuela				
Cerro Bolívar	Ferrominera Orinoco	Fe	11	c.a.
Altamira	Ferrominera Orinoco	Fe	4.5	c.a.
El Pao	Ferrominera	Fe	4	c.a.

c.a.: Open pit
sub.: Underground

Annex III

ARGENTINA, BRAZIL, CHILE, PERU AND VENEZUELA
NUMBER OF OPERATING MINES CONSIDERED IN THE STUDY

10^6 t ROM/Yr.	Open Pit				Underground		
	Cu	Fe	Bauxit	Polimet.	Cu	Fe	Polimet.
Under 0.5	2			2		1	3
0.5			2		1		8
1	3	1			1		
2		5					1
3	2	2			2	1	
4	1	2	1				
5		3			1		
6	1						
7	1	2					
8		2					
9		2			1		
11		1					
12		2					
15		1					
16	1						
18	1						
22					1		
25	1	1					
36		1					
TOTAL	13	25	3	2	7	2	12

Annex IV

LIST OF METAL ORE MINES IN ARGENTINA, BRAZIL, CHILE, PERU, VENEZUELA AND SPAIN INCLUDED IN THE ANALYSIS OF OPERATING MACHINERY AND EQUIPMENT FOR ESTIMATING THE POSSIBLE REQUIREMENTS OF MACHINERY AND EQUIPMENT ARISING FROM NEW MINING PROJECTS

Location	Country	Mineral	Estimated Production rate 10^6 t ROM/Yr.
Underground			
Madrigal	Peru	Cu, Pb, Zn, Ag	0.4
Sotiel	Spain	Cu, Pb, Zn	0.6
Rubiales	Spain	Pb, Zn	1.0
Cobriza	Peru	Cu	3.0
Rio Blanco	Chile	Cu	5.0
Salvador	Chile	Cu, Mo	8.5
El Teniente	Chile	Cu	22.0
Open pit and underground			
Cerro de Pasco	Peru	Cu, Pb, Zn, Ag	2.0
Mantos Blancos	Chile	Cu	4.0
Open pit			
Cumobabi	Mexico	Cu, Mo	0.7
Lo Aguirre	Chile	Cu	1.1
Bodovalle	Spain	Fe	2.2
Los Pijiguaos	Venezuela	Bauxit	3.0
Los Bronces	Chile	Cu	3.0
Cerro Colorado	Spain	Cu	4.3
Mutuca	Brazil	Fe	5.0
Cerro Verde	Peru	Cu	5.0
Quellaveco	Peru	Cu	7.0
Cananca	Mexico	Cu	11.0
Capanema	Brazil	Fe	11.5
Toquepala	Peru	Cu, Mo	13.0
Altamira-El Pao	Venezuela	Fe	14.5
Aguas Claras	Brazil	Fe	15.0
Cuajone	Peru	Cu, Mo	16.0
La Caridad	Mexico	Cu, Mo	25.0
Chuquicamata	Chile	Cu	30.0
Carajas	Brazil	Fe	35.0